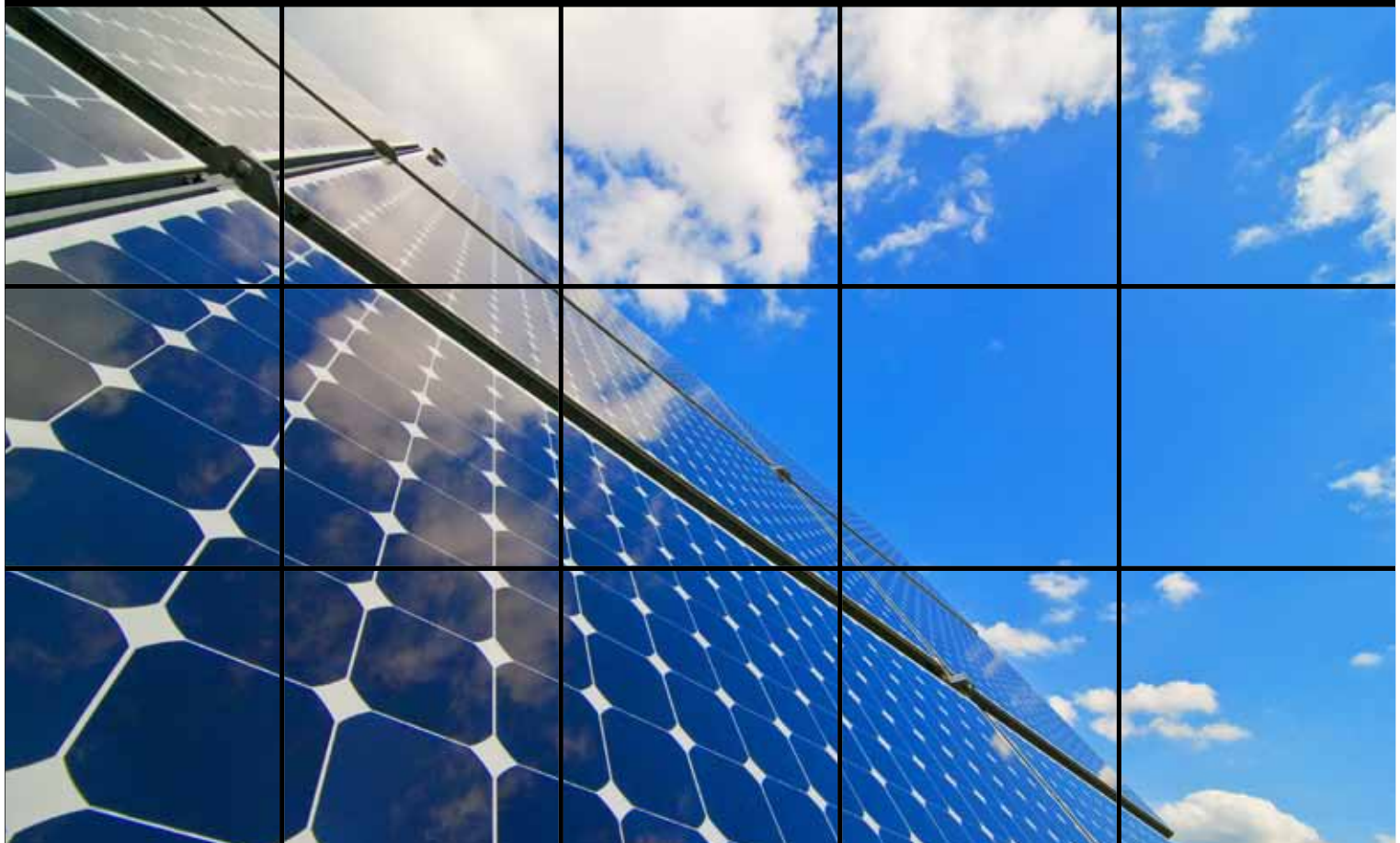




Financing Innovation: Viewing the UK from a global perspective

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Transcript of a talk by Professor Michael Mainelli
AEA & Wolfson College Seminar
8 February 2010



Outline

Well, as we say in Commerce – ‘To Business’.

Tonight’s discussion is about funding innovation. Annual, global investment in technology is enormous. Research & Development (R&D) alone is 1% to 3% of GDP in OECD countries, approximately £275 billion in the 1,400 largest multi-nationals and uncounted billions in small organisations. Without technological change, advancement in productivity and therefore GDP would be limited to increasing labour and material productivity, finite sources of improvement. In the words of Michael E Porter ‘Innovation is the central issue in economic prosperity’.

The compelling argument that improving living standards requires improved technology makes governments, universities, research establishments, think tanks and even trades unions talk confidently about turning nations into ‘knowledge economies’. And, clearly, given the focus on innovation by Government, the media and business, we want more of it.

In many ways, innovation bears hallmarks of religious fervour. If your faith in innovation is strong enough, you will prevail. If you fail, you need more innovation. Tonight, I intend to explore three observations on innovation:

1. A diverse, competitive ecosystem generates innovation.
2. Government can’t direct innovation.
3. Government policy should focus on education and diversity, with low risk and high rewards for entrepreneurs.

Breeding innovation

What can you say that’s new about innovation and economics? Edmund Burke (1729–1797), writing about the French Revolution, was not exactly a fan of wanton innovation: ‘A spirit of innovation is generally the result of a selfish temper and confined views.’ Perhaps the last great insight into innovation and economics came from the economist Joseph Schumpeter in 1942 with his concept of ‘creative destruction’. Creative destruction means markets create new things. New things that must displace existing things. To Schumpeter, entrepreneurial innovation sustained long-term economic growth, while simultaneously destroying the value of established companies that enjoyed some degree of monopoly power.

Successful innovation erupts from economic systems full of birth, struggling, killing, eating, breeding and dying. Allister Heath writing in CityAM on 3 February 2010 of the Conservative economic plan [‘Tory Economic Plan Is A Damp Squib’, page 2] said ‘The claim that they will make Britain “Europe’s leading hi-tech exporter” by boosting venture capital and the teaching of science is laughably optimistic. The best way to help venture capital would be to give it massive tax breaks, which they don’t want to do. Better training is not enough: the Soviet Union had the best scientists and the worst economy. You also need some real capitalism.’

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Fostering innovation

As a child, like many in tonight’s audience, I worshipped innovators - Edison, Kelvin, Bell, Fleming, Morse, Faraday, Goodyear, Eastman, Carver, Shockley, Watson, Crick and Fermi, just to get started. I fancied myself as a great inventor. Ultimately, I did go on to help develop some minor innovations in aerospace, laser line-following digitisers and pattern recognition, but found the subject of innovation most pertinent when trying to commercialise the UK’s defence technologies in the 1990s and as an investor in a variety of technologies from ICT to metal foams, advanced fibres, high-tensile glass, desalination, cleantech, etc. I began to realise that I know too little about fostering innovation.

Numerous people distinguish invention from innovation. ‘Consider, for example, Chester Carlson’s breakthrough in his flat in Queens, New York, where his smelly experiments provoked complaints from the neighbours. His invention of xerography would never have become the hugely profitable Xerox photocopying business were it not for what Charles Ellis calls the “extreme entrepreneurship” of Joe Wilson.’ [The Economist, ‘Innovation and Entrepreneurship: No Fear of Flying’, 18 November 2006, page 98-99]. Invention is having a great idea that might be practical; innovation is introducing it to

the world. Schumpeter tried to define innovation, but his definition encompassed all change, new goods, new methods of production, new markets, new supply sources and new organisation.

Innovation according to Schumpeter...

- **The introduction of a new good – that is one with which consumers are not yet familiar – or of a new quality of a good.**
- **The introduction of a new method of production, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially.**
- **The opening of a new market, that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before.**
- **The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.**
- **The carrying out of the new organization of any industry, like the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position.**

‘User innovation’, when people use products and services in ways unplanned by designers, is increasingly recognised as another source of economic transformation. The OECD attempts in its Oslo Manual to define and measure innovation. For the OECD, nothing is an innovation until people buy it – innovation is about making a difference in the marketplace. Of course, the next problem is that every commercial move is defined as an innovation. Every novel wrapper for a burger, every new phone-answering phrase, every inventive internet click function, every new fashion accessory. Momofuku Ando, inventor of instant noodles, is as important as Thomas Alva Edison.

The definitional problem is profound. New inventions that aren’t commercialised aren’t innovation. If one company is superior to its competitors, that’s because it is innovative. If a company fails, that’s because it wasn’t innovative enough. Even worse is the notion of ‘disruptive technology’ (ie technological innovation that overturns the dominant technology or product in the market, eg steamships for sailing

ships or microcomputer for mainframes). Of course, this disruption is unpredictable. But there are still sailing ships and mainframes, so when is innovation truly disruptive? We then find ourselves having to distinguish between unique innovations, virtually unique innovation (sic), revolutionary innovations, virtually revolutionary innovations and just bog-standard improvements. Which reminds me of two economists walking down the street who notice two men yelling across the street at each other. ‘Of course they will never come to agreement’, states the first economist. ‘And why is that’, inquires his companion. ‘Why, of course, because they are arguing from different premises.’

Innovation has become synonymous with success, confusing us further. This conflation of innovation with success is especially surprising as it has long been recognised that failure is an important part of learning and innovating. George Chapman (1559-1634) noted in the 16th century that ‘Pure innovation is more gross than error.’ Given the all-encompassing definition of innovation, that innovation is the successful bringing to market of novelty, the confusion of innovation with success is not surprising. Innovation is simultaneously noble failure and unexpected success. Woody Allen summarises ‘If you’re not failing every now and again, it’s a sign you’re not doing anything very innovative.’

My favourite definition is to paraphrase Arthur C Clarke ‘Any sufficiently advanced solution is indistinguishable from innovation.’ We can’t define innovation, so we wind up mimicking Justice Byron White on pornography ‘We know it when we see it.’ If we can’t define innovation, how can we hope to finance it?

Font of new ideas

What is the source or font of innovation? Many economists would prefer to ignore this awkward question. The Nobel prize-winning economist, Robert Solow, wrote two seminal papers on growth in 1956 and 1957. But in his papers ‘Invention, innovation and ingenuity were all “exogenous” influences to [technological progress]’ [The Economist, Economics Focus: ‘The Growth Of Growth Theory’, 20 May 2006, page 96]. If we can’t find the source of innovation, how can we hope to finance it?

Let’s start with a quick look at Britain’s performance. Figures are inevitably confused as businesses do not use the same metrics for innovation as governments,

as defence spending on R&D is confusingly public/private, as much innovation occurs outside of R&D in marketing, design, engineering or even training. Most of what gets measured is expenditure. On overall R&D expenditure, the UK is not performing brilliantly, though it is attracting lots of overseas R&D as well as venture capital. From the OECD 'In 2008, the United Kingdom accounted for over 10% of all venture capital investments in the OECD area, the second largest share after the United States (49%). Total R&D intensity (1.8% of GDP in 2007) is slightly below the OECD average (1.9%). UK businesses finance only 47% of total R&D expenditures, against an average of 57% for G7 countries. In 2008, defence accounted for 24% of the Government R&D, the third largest share in the OECD after the United States and France.'

Industry spend is dominated by pharmaceuticals.

We also value patent quantity over quality. In the Government's 2008 'Innovation Nation - Background analysis: strengths and weaknesses of the UK innovation system', page 5, there is a fairly realistic assessment of mediocre, though, to be fair, not poor performance.

'Innovation performance is not easy to measure at a firm or whole economy level. The most long-standing business innovation indicators are R&D expenditure and patenting, where, on normalised measures, the UK trails most G7 economies.' The strengths - some excellent universities and significant public and private investment in R&D. The weaknesses - declining educational standards, particularly in science, technology, engineering and mathematics, along with an oversized, sluggish public sector with falling productivity.

Of course, you manage what you measure, but you measure what you can. I set out below some measures and indices that my firm tracks. The number beside each index is the UK's rank. From these, you can see that the UK does not score particularly well among the countries of the world as a place to do business. Many of these scores slid to their present position over the past five years, but we don't seem to hear much protestation about our mediocrity across such a wide range of factors. Some other things pop out. For example, wholesale finance: good, retail and commercial finance: terrible - 31st in ease of access to capital, 55th in access to credit. The equity funding gap, if it exists, falls squarely into an oligopolistic banking industry where three banks control the vast majority of the market, in contrast to other countries.

Ranking outsiders

- Business Environment (28)
 - Ease of Doing Business Index (9)
 - Global Services Location (24)
 - Corruption Perception Index (22)
 - Wage Comparison Index (18)
 - Corporate Tax Rates (24)
 - Employee Tax Rates (46)
 - Tax % of GDP (28)
 - Index of Economic Freedom (18)
 - Economic Freedom of the World (15)
 - World Competitiveness Scoreboard (33)
 - Global Competitiveness Index (22)
 - Business Confidence Index (36)
 - World's Most Innovative Countries (28)
 - E - Readiness Score (21)
 - Foreign Direct Investment Inflows (10)
 - JLL Real Estate Transparency Index (12)
 - Ground Transport Network (42)
 - Capital Access Index (7)
 - Gross Tertiary Graduation Ratio (22)
 - Visa Restrictions Index (26)
 - Human Development Index (30)
 - Quality of Living Survey (25)
 - International Crime Victims Survey (22)
 - Cost of Living (17)
 - Average Days Precipitation per Year (58)
- Z/Yen Indices**
- Global Intellectual Property Index (1)
 - Global Financial Centres Index (1)

Analytical framework – Motivated Donkey Theory

I would now like to present a complex theory of funding. Before I do so, may I please have a show of hands for two questions?

- 1 Hands up those who believe that people should be rewarded for good performance.
- 2 Hands up those who believe that failures are part of learning.

Let's call this the 'Motivated Donkey Theory'. The donkey wants to get the carrot, avoid the stick and stand in lush grass. Obviously, the donkey is the investor, the carrot reward is financial return, the sticks are the risks of failure and the grass is infrastructure. I don't want to insult you with the simplicity of the model, but far more complex models of funding innovation are rarely any improvement. If you've been on both sides of investment as I have, this risk/reward model is simple and works.

Notice that innovation doesn't feature in this model. Investors invest to make money, not to innovate.

Carrots

Before you dismiss money as too simplistic, note that as much as people lament the inability to fund British technology companies, investors have happily backed bubbles such as dot.coms and property. Outside of film, art or book investors, there is a simple point often overlooked for everyone else, people invest to make money. Yes, there are other carrots involved. I can vouch that pride in good work, the prestige of seeing something you've designed used by millions, the fun of seeing a product grow or vindicating an idea are all important. But the big financial driver is money.

It is at this point that I must raise a depressing Tax Squeeze Spin. Over the years, a number of European trade and industry officials have wondered why Europeans develop fewer entrepreneurial businesses. A colleague, Dr Kevin Parker, trains scientific entrepreneurs. He estimates that the budding North American technology entrepreneur has a 1 in 30 chance of actually making the leap. His estimate for the UK is that 1 in 150 will make the leap.

European tax rates are typically at an effective 50% level for most middle-income families when all taxes are taken into account. Most rational Europeans, and most of us are, should stay in jobs with large private or public organisations till we are eligible for pensions. Why take risks with our long-term family incomes? My brother in the USA has no pension and an effective 35% tax level when all taxes are taken into account. It's no surprise that Americans can take more entrepreneurial risks funding their brothers-or-sisters-in-law starting up in their garages. They can afford to lose more.

The answer to Tax Squeeze Spin is lower tax rates. But, of course, it garners more votes to pledge more money to Government R&D, to spend more money on innovation awareness campaigns, to subsidise private sector R&D and to try and develop more networks of business and academia. But, all this effort costs money and increases tax rates making Tax Squeeze Spin worse. Policymakers don't like the answer that less policy and less tax could make Europe far more innovative.

Sticks

Sticks are all the things that can go wrong, that lose you money. The biggest stick is competition. Competition also attracts businesses by creating clusters and demonstrating an open economy. Investors investigate risk factors and watch indices and ratings. 'The decision to locate Research & Development facilities is complex and influenced by a variety of factors, of which nationality of ownership is only one.' [Bulli, page 20]. Market access and potential is always important. Second, investors look at their ability to get their money out after tax, business-friendliness and trust in the fair application of commercial law. Third, investors look quite obviously for bright people, the availability of quality personnel. Finally, innovation investors look for specific R&D facilities and knowhow. Market access, getting money out and bright people count for more than R&D police.

Grass

In the past two years or so, pessimism has become the new black, but blackest for me are overseas clients claiming that the UK is a big political risk. I ask why. What I get, in heavily accented English, is tax since 2007 – changes in six months to non-doms, capital gains tax, foreign dividends and trusts. First a proposed 45%, now a 50% tax rate. On access, they complain about visitors' visas, work visas and ID cards for non-EU nationals.

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Then they mention terrorist legislation used against Iceland. Then they point out that it's difficult to get fair treatment in a country where the government controls the banks, whether it's a banana republic or the UK, the courts won't operate fairly. When I defend fairness in UK courts, overseas clients point out the 1992 case, Hammersmith and Fulham Council versus Hazell, or point to windfall taxes on energy or finance. Perhaps we need a new UK reality show 'I'm an investor ... Get me out of here!'

Of course, many of these sticks are actually the inverse of good infrastructure. I'd like to spend a minute on two fairly typical reactions to funding innovation – trying to manage innovation better and throwing government money on innovation. In 1987, Freeman first explicitly expressed the concept of a 'National Innovation System' as '...the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies.' Michael Porter has been influential in directing government attention to regional innovation clusters driving national innovation systems, particularly in his 1990 book 'The Competitive Advantage of Nations' where he introduced the notion of an interlinked 'diamond' cluster consisting of demand conditions, factor conditions, firm rivalry and supporting industries.

Corporate funnels

Fairly typical technology funnels generate interesting figures on technology commercialisation. It takes about 100 research ideas to generate about 10 development projects, of which two will usually make it through to commercialisation. Only one will actually make money when launched. In Britain and America, around half of companies' development money is spent on projects which never reach the market. But, if the large corporate track record is two out of 100, small entrepreneurs may have worse odds. 'Of 1,091 Canadian inventions surveyed in 2003 by Thomas Astebro of the University of Toronto, only 75 reached the market. Six of these earned returns above 1,400%, but 45 lost money. A rational manager will balk at such odds. But

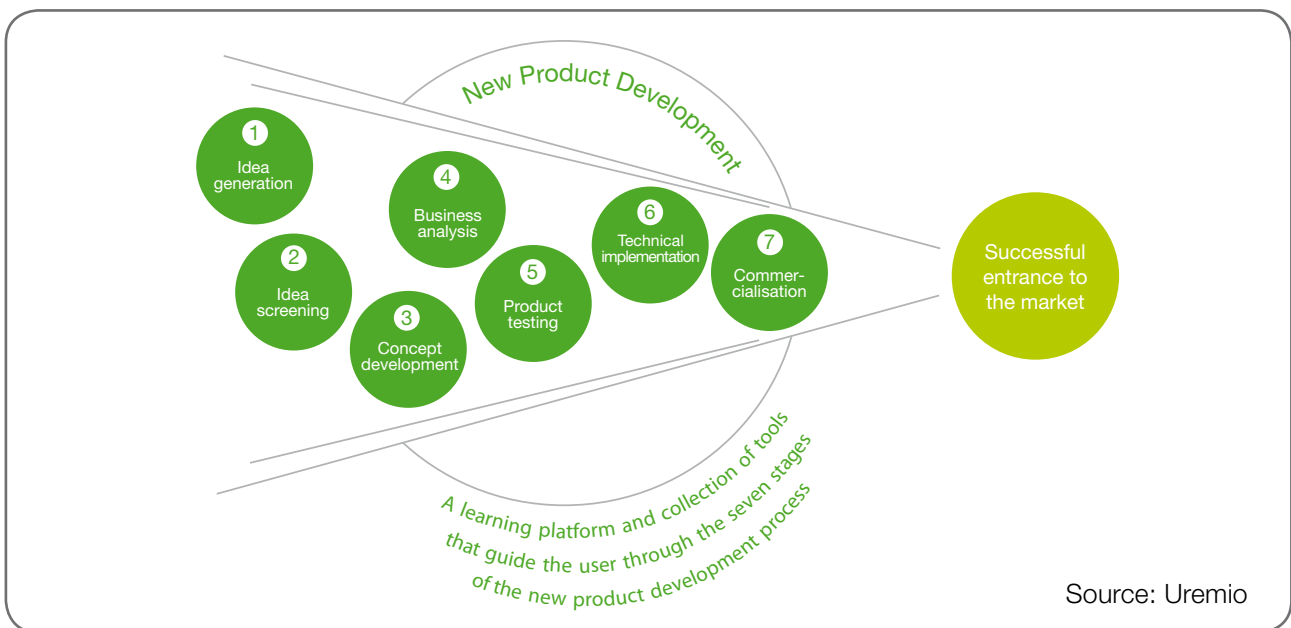
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the entrepreneur answers to his own dreams and demons.' [The Economist, Economics Focus: 'Searching For The Invisible Man', 11 March 2006, page 86]. Worse, much research has shown that successful entrepreneurs vary so wildly, from the meek to the wild, from the octogenarian to the child, that it is hard to distinguish entrepreneurs in advance from the general population. Entrepreneurial nature wins over entrepreneurial nurture.

All large corporates would like to be called 'innovative'. 'Innovation culture' dominated the R&D management literature in the 1980s at, for instance, 3M, DuPont and GE. Steve Jobs said that 'innovation distinguishes between a leader and a follower.' It is easy to find articles stating that the job of organisations is to innovate. There are two religious sects for corporate leaders, both stark



and unforgiving - top-down versus bottom-up. In the top-down sect, policy and planning lead to new innovations. In the bottom-up sect, of wild markets and innovation, you have no idea from where the next big idea will come. Sadly, large numbers of stories show that large companies are not that good at 'hard', measurable innovation of the top-down variety. Governments, companies and professional commentators are also particularly bad at spotting winners. Sherden, in his delightful 1998 book 'The Fortune Sellers' tears apart any structured ability of government or private 'futurologists' to spot winners in science or technology.

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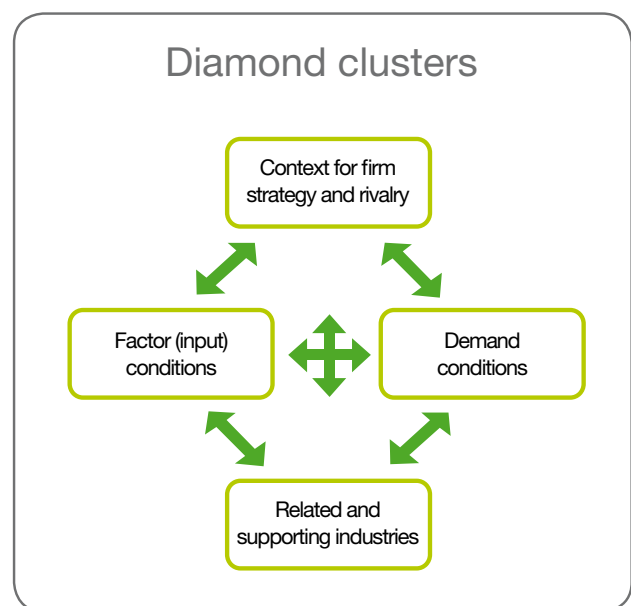
But bottom-up innovation means corporate headquarters has no idea where the next big idea will emerge to justify being a large corporate, a very uncomfortable situation, so naturally large corporates want to buy innovation consultancy snake oil. Businesses in rapidly moving industries develop through a blizzard of partnerships, joint ventures, alliances, minority participation, IP exchanges or know-how agreements. I particularly like this marketing blurb for the book 'Weird Ideas That Work: 11½ Ways For Promoting, Managing and Sustaining Innovation', which points out why innovation is subversion in large firms 'There are massive rewards for original thinking, but an innovative company is – and has to be – a pretty weird place. Convinced that their ideas will work, creative people deceive their managers and disobey direct orders. They are sneaky, vindictive and misguided to the point of lunacy. They try ridiculous things and dismiss the advice of experts. Not only are true creatives messy and noisy, they're almost always wrong. And that's if you're doing it right.'

Perhaps the balance of large, corporate R&D is moving from top-down to bottom-up, but evidence is scanty and anecdotal. There is little correlation between R&D expenditure and sales growth. Leaving out a few merger-driven name changes such as Novartis, Astra- Zeneca or Sanofi-Aventis, 18 of the top 20 global R&D spending organisations [in 2008] would have been recognised 50 years ago (the exceptions being Intel - 15th, Microsoft – 1st). Perhaps R&D in many industries is just a labelling game.

One of my colleagues, Stephen Martin, tells a story of a former boss, Frank Lynn. Frank Lynn was part of a think tank put together by Jimmy Carter to answer the question 'If the USA is so good at inventing new things - how come we don't launch that many new products?' Frank concluded that by the time a company has grown enough to invest in R&D, its channels to market have matured to the point where they are no longer suitable for launching and selling the output of R&D.

Trying to get better at managing innovation as a process is paradoxical. Still, how can one fault trying to improve? The problem is when too much resource is spent chasing a mirage that innovation can be managed.

Unfortunately, diamond clusters rather unglamorously direct government to getting the conditions right, making sure the soil for innovation is fertile, not directing innovation.



With just a little Schadenfreude, I remember 1982 when the Japanese Ministry of International Trade and Industry made computing its priority. Europeans, and to a lesser degree Americans, were a-twitter. The Japanese were spending \$1 billion (when \$1 billion was a lot of money) on their Fifth Generation Computer project. The Fifth Generation Computer Project aimed to create an 'epoch-making computer' with supercomputer-like performance and usable artificial intelligence capabilities. All that money and more disappeared into what is widely regarded as a failure. Where is the Japanese Google or Microsoft?

Of course, we had Alvey and Esprit at the same time. Innovation support proliferates innovatively - technology transfer programmes, networking ventures, licensing schemes, development agencies, military technology exploitation (spin in and spin out), fox and geese programmes, Foresight or EU Framework Programmes For Research And Technological Development, Numbers 1 To 7.

The UK Government has fervently funded electronics and aerospace since the war to the point that there is no global UK electronics firm and one sort-of aerospace firm that is, in truth, really just a military contractor with two-thirds of its earnings coming from three governments. It is amusing, and saddening, to work out that government-funded research efforts tend to result in the demise of the industry concerned, whether it is European, Asian or American.

OK, it's tough to figure out how to manage innovation better for governments or large firms, so why not just throw other people's money at the problem? Global markets have meant that technologists compete globally. It's no longer good enough to be the best in Britain. Investors want firms with global capabilities and ambitions to compete in the global markets. Globalisation of technology leaves us feeling behind and therefore 'somebody has to do something'. It is no surprise, therefore, that since the 1950s people have become more and more convinced that government should play a direct role in innovation, from the 'white heat of revolution' to 'Cool Britannia'. A typical European publication by Science Business, The Innovation Manifesto, wails over poor university licensing revenues in Europe, ineffective technology transfer offices or expensive patenting, but then the Manifesto oddly concludes that more government support is needed.

The answer is certainly not more subsidy, as the OECD points out 'Over 1999-2008, the [UK] rate of R&D tax subsidies for large firms increased by 10 percentage points and become in line with the OECD. The [UK] rate for SMEs is higher than

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the OECD average.' Governments like to claim credit for innovation and jobs. There are two great problems in evaluating government involvement in innovation – the pervasive nature of governments in the OECD, hovering around 40% of GDP, and the fact that governments evaluate innovation on column inches, not financial return. For an example of pervasiveness, just take government funding of universities. Anyone with a degree can be claimed to be government funded. Anyone with a job in a subsidised country can be claimed as a beneficiary of enlightened technical and industrial policies. Likewise, governments tend to use idiosyncratic examples of successful companies as proof that government policies or subsidies lead to success. If you give a £1 to every company in the country, you can rightly claim to have subsidised every successful company around. But you will waste a lot of money.

I can't help but remind you of Ronald Reagan's view of government 'Government's view of the economy could be summed up in a few short phrases: If it moves, tax it. If it keeps moving, regulate it. And if it stops moving, subsidise it.' We should smirk when we apply Reagan's dictum to R&D – governments and voters presume R&D needs subsidising, so R&D must already have stopped moving.

The evidence of all this effort is mixed. Richard Thaler supposedly pointed out 'when an economist says the evidence is "mixed", he or she means that theory says one thing and data says the opposite.' Let's take a quick look at some numbers that dispel quite a bit of flimflam. This is a chart of Government funding of R&D as a % of GDP against GDP growth along the bottom.

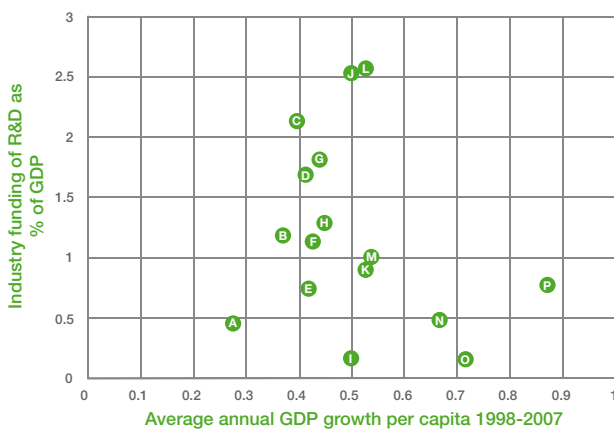
Government Funding ≠ Growth



Key: A: Italy B: Denmark C: Japan D: France E: United States
 F: Germany G: Austria H: Belgium I: Portugal J: Sweden
 K: United Kingdom L: Finland M: Netherlands N: Spain
 O: Greece P: Ireland

No correlation between Government funding of R&D and GDP growth. Interestingly, Dr Alex Smeets of the St John's Innovation Centre in Cambridge suggests that economic indicators show positive correlations with R&D spend, but only up to just under 1.5%. Above that, further spending doesn't help. Contrast that with the EU's Lisbon target of 3% and the UK target of 2.5%. Even then, with the wall of Government debt falling around us, it's unlikely that Government spending on R&D is the answer to anything.

Industry Funding ≠ Growth



Key: A: Italy B: Denmark C: Japan D: Germany E: Austria
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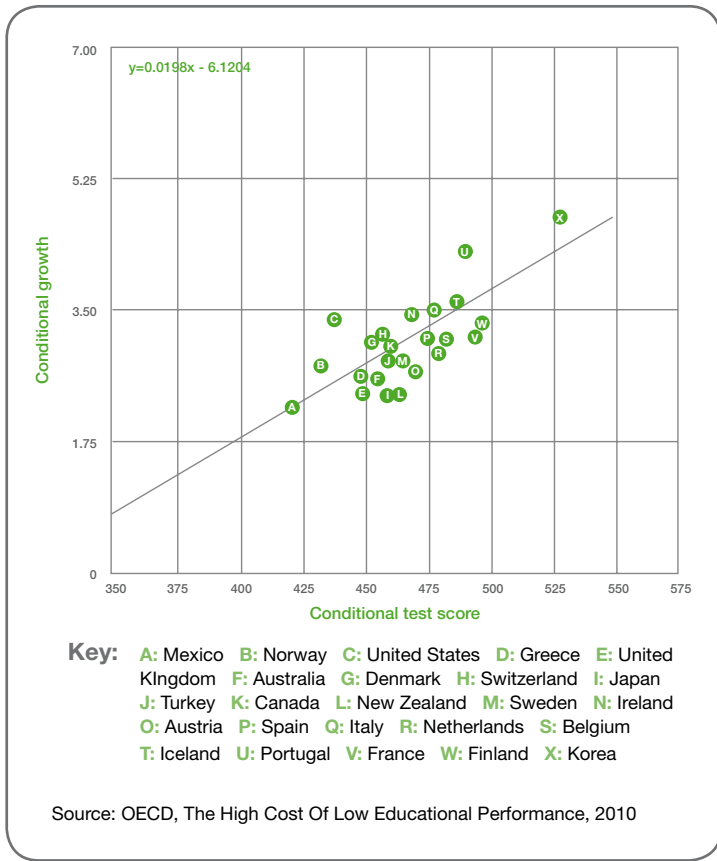
However, before I seem anti-government, we equally find no correlation between industry funding of R&D and GDP growth either. Innovation is a diffuse, even elusive beast. We can't define nor track innovation, yet we claim to manage it. Our earlier definitions claim that innovation exists when competitive organisations improve. We do define investment, we do track it and we do manage it. On inward investment and venture investment, the UK does well compared to the rest of Europe, though we can improve. Give up on the R&D numbers, but watch those investment numbers for new ventures carefully.

Competitive positioning

So what do we want? Is this our ad 'Island nation recently divorced from temporary windfalls in oil and finance seeks new technology industries'? All we have to sell are brains and connections. Professor Raj Persaud pointed out a hard truth 'No matter how hard you're prepared to work, and I'm sure you're all very industrious individuals, there are millions of people in India and China willing to work harder than you for about a tenth of the pay, okay? So, as a national economy, for us to be competitive in the future in this world, we can't rely on resources and we can't rely on hard work. What are we going to rely on? We're going to have to rely on innovation, being different and being creative.'

If governments can't directly fund or manage innovation and large firms are bad at it, and entrepreneurs are our only salvation, how can policymakers increase innovation? Carrots, sticks and grass again. Carrots are greater rewards, for example through lower and simpler taxes or better regulation and lower risks of failure (eg better information - more take-home money for investors - simpler, effective patent systems). Sticks are strong rivalries, emerging from equal-handed legal systems and strong anti-monopoly conditions; demanding customers, developed through strong consumer rights legislation and open borders; open flows of information and ideas; easing open flows of people (eg refugee academics or transferable pensions). Grass is good factor conditions, created by good infrastructure, education and open capital markets. But I'd like to emphasise two points, one direct, education, and one subtle, diversity.

Education matters



Most recent studies show the UK falling in basic educational performance over the past decade, from 4th to 14th in science, from 7th to 17th in reading, from 8th to 24th in maths. We can argue a bit about exact positioning and methodologies, but education must be the biggest focus of Government policy to avoid the UK being renamed Mediocristan.

The OECD estimates that raising our educational performance to that of Finland will increase GDP growth by 0.5% per year. We should be proud of some top international universities, but we desperately need to stop the slide into mediocre education elsewhere.

Biologically diverse innovation

Perhaps the most subtle innovation policy is that of diversity. Ashby's Law of Requisite Variety, originally from cybernetics, states that for appropriate regulation, the variety in the regulator must be equal to or greater than the variety in the system being regulated. Or stated another way, the greater the variety within a system, the more regulation will reduce its variety. Significant government direction of R&D inevitably reduces the essential variety behind

true innovation thus, as innovation is about variety, government direction of R&D is necessarily inferior to no direction. Government spending pushes size up. You have to be big to afford bidding, big to navigate the policies and subsidies. Unnecessary size leads to more regulation, interference and even corruption, as well as homogeneity.

This leads us back to the most fertile ground for innovation being the allotments of sole entrepreneurs or very small teams who organise, manage and assume the risks of a business or enterprise. I am not praising small exclusively, nor am I claiming that large corporates aren't equally important for development and distributions. Nor do we need innovation leaders or heroes. 'Unhappy is the land that has no heroes,' comments a character in Bertolt Brecht's Life of Galileo. 'No' replies another 'Unhappy is the land that needs heroes.' Early in the last century, Schumpeter argued that innovation and technological change comes from entrepreneurs or wild spirits. His German phrase was *Unternehmergeist*, entrepreneurial-spirit. Later, Schumpeter contradicted himself when he saw that in the United States, big companies, which have the resources and capital to invest in research and development, are also real movers. We need diversity; we need big and small.

We live in a world where we must expect the unexpected, predict the unpredictable and think the unthinkable, as well as not think about elephants. As with other ecosystems, governments should pursue policies that encourage biodiversity. Biodiversity means favouring firm creation rather than national champions. Biodiversity means encouraging competition, so that one type of firm does not unnaturally predominate. Biodiversity requires aggressive anti-monopolies enforcement. Biodiversity means not leaping in too early with standards and regulations.

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From an economic perspective rather than a legal one, many of the difficulties with intellectual rights stems from avoiding some of the economic conclusions. For instance, trademarks and patents are markets limited by rationing based on trademark and patent office resources. Rather than attracting more resource if things get busy, poorer work is done. There is a fixed price, set at a high base level for the work. There is little redress if a patent or trademark is poorly awarded. There is a fixed cost to enter the commons, but little return to the public based on what people take from the commons. Copyright is a confused market with no barriers to entry.

One approach I might suggest would be to reintroduce the concept of a market, agreed between the state and individuals. Let's call this a Controlled Options Market for Intellectual Rights. All main types of intellectual capital would follow a similar regime – application, screening, registration, maintenance, expiry. Having required all three basic rights to have a common registration procedure, that is, patents, copyrights and trademarks, (something new for copyright in modern times) the two basic steps to get this to work would be:

- Issue at auction a strict number of tradeable options to file patents, copyrights and trademarks each year, for different durations.
- Set a requirement for patent, copyright and trademark offices to indemnify prior art and other safeguards by quoting a price for the indemnity (insurance) and publish the amount of the indemnity and the amount paid by the applicant.

This approach would provide dynamic pricing of the value of these monopolies on the traded option market (ie how much do people and companies wish to pay to gain a monopoly). If the price is very high, crowding out smaller players, then we may wish to have a societal debate as to how much protection, how much resource and how many instruments we wish to issue. If the price is very low, then we get a better flavour of what matters and can trim resource. We can see clearly if these offices are effective, based on what people are

prepared to pay to have access. The option means that the patent, copyright and trademark offices have orderly queues, while the indemnity means that the degree of risk of sloppy work is clear and they still have to keep up standards of acceptability. If the indemnity is reinsured, then we have even better market indicators of risk. If we accept the concept of competing offices sharing a registration database (somewhat similar to the international patent office situation today), then, for example, Patent Office A can be contrasted with Patent Office B on economy and efficiency measures as well.

Great circle of commerce

Of course, innovation isn't everything - as Coco Chanel said: 'Innovation! One cannot be forever innovating. I want to create classics.'

I hope you've enjoyed this short exploration of three observations that may help this evening's discussion:

1. A diverse, competitive ecosystem generates innovation.
2. Government can't direct innovation.
3. Government policy should focus on education and diversity, with low risk and high rewards for entrepreneurs.

Schumpeter gave us a construct, creative destruction, that is analogous to the Hindu view of Shiva – the creator and destroyer – or the 'Boethian Wheel'. Boethius' 'Wheel of Fortune' was popular throughout the Middle Ages. Men may rise from poverty and hunger to greatness, while those who are great may fall with the turn of the wheel – from dust to dust. Of all the firms in the ecosystem, by far the ones that keep it going, as bacteria, fungi, beetles and worms do in biological ecosystems, it is the little folk that matter. The ones that will grow need the older ones to die. If we can clear the forests of policies, financiers will find the good little firms themselves. If we want to finance innovation, paradoxically we should just focus on getting the basics right.